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**Remarks**

Paragraph 37 has been corrected to show proper subscripts in the matrix. A formatting error has been corrected in paragraph 38.

Claim 1 has been amended to correct the presentation of the mathematical formulae. Also, the explanation of  $S_{IN}$ , which equals  $X_0$ , has been further clarified.  $S_{IN}$ , of course, comprises the echo source signal, after it has traveled the echo path, plus any double-talk that may be present. The applicants have also specified that the adaptive filter operation is adjusted in response to the detecting step (see paragraph [0050]).

Figure 3 has been corrected to remove the matter considered new by the examiner. The wording of box 12 in Figure 3 now conforms to the disclosure and the wording of claim 1. It appears that it was only the wording "to determine correlation between components of matrix R" in box 12 of Figure 3 that the Examiner found objectionable.

The Examiner is respectfully requested to reconsider his rejection to claim 1 because it is respectfully submitted that the prior art in combination does not show the particular combination claimed.

With regard to Betts, it is respectfully submitted that this is non-analogous art and inapplicable to the present invention. Betts is concerned with echo cancellation in a two-wire circuit interconnecting modems. In Betts, the near-end modem receives an echo of its transmitted signal in its received signal. Betts cancels out the echo of the signal transmitted from the near-end modem in the signal received by the near-end modem from the far-end modem. The particular problem with which Betts is concerned is the fact that when the far-end modem is dropped there is an increase in echo energy which the near-end modem can mistake for a signal from the far end modem. Betts has nothing to do with double-talk detection. In order to overcome this particular problem Betts correlates the echo estimate signal with the transmitted signal, which, according to Betts, "is the source of the echo signal".

It is not clear what the status of Betts is in connection with the 103(a) rejection. The Examiner has not rejected claim 1 over Betts, but merely appear to have used Betts to interpret Benesty without making it part of the combination of references applied to claim 1. It is respectfully

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submitted that such an approach is improper, especially as Betts is concerned with an entirely different problem.

The applicant admits in the application that correlation-based approaches to the problem of double-talk detection are known and refers to Ding at line 9, page 3. As pointed out by the applicant, the problem with such an approach is that the degree of correlation can vary widely with different signals and echo paths, a fact which makes it very difficult to set thresholds on the correlation coefficient in order to determine what state the echo canceller is in.

The matrix approach is clearly not suggested by Ding, which discloses nothing more than the prior art acknowledged by the applicant. The Examiner relies on Benesty as allegedly disclosing the matrix approach, but argument is respectfully traversed. In order to render an invention obvious the Examiner must find all the features of the claim in the cited prior art, either expressly or inherently. Claim 1 clearly states that the matrix is formed from signals, which in Benesty would be  $y^{(n)}$  and  $y(n)$ , whereas Benesty only suggests using signals  $x(n)$  and  $y(n)$ . The fact that in a the non-analogous art of detecting dropping of a far-end modem the transmitted signal may be considered as "effectively" the same as the echo signal does not necessarily make received signal effectively the same as the echo estimate in the field of double-talk detection. A combination of Benesty and Ding, even if proper, which is not admitted does not result in the invention as claimed.

Moreover, claim 1 doesn't just call for the use of *any* matrix, but rather the particular cross-correlation matrix

$$R = E [x x^T]$$

where  $E$  is the statistical expectation operator as set forth in the claim. This matrix is not discussed in Benesty and permits the effective recognition of double-talk and path changes as shown in Figures 2a to 2c and explained on pages 8 and 9 of the disclosure, which show that as defined  $R$  is a symmetric correlation-based matrix.

The Examiner refers to Figure 2 of Benesty, but this does not refer to the use of a matrix, which is only discussed in very general terms, but instead to the use of a cross-correlation vector which consists of a normalized correlation between a vector and a scalar. In Benesty,  $\xi_2$  refers to equation 9. Any motivation for combining the references based on Figure 2 as suggested by the Examiner would thus result in the use of a vector and a scalar, not a matrix.

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Benesty is a vague in the discussion of the cross-correlation matrix. All he purports to show is that there is a link between his normalized cross-correlation matrix, which is defined as  $C_{xy} = R_{xx}^{-1/2} R_{xy} R_{yy}^{-1/2}$  and coherence. But he clearly does not propose generating the particular cross-correlation matrix defined in claim 1. The Examiner is silent with regard to the particular form of the cross-correlation matrix as expressly set forth in claim 1.

With regard to Ding and Taguchi, it is noted that Ding, in the passage cited by the Examiner, merely refers to the use of a cross-correlation technique between various signals to arrive at a control decision. Ding goes on to say that this technique is "not deemed to provide an adequately reliable detection scheme" (line 15, column 2), thus directing one skilled in the art away from using such techniques. As noted by the Examiner Ding does not use the transmit signal  $x(n)$  and the receive signal  $d(n)$  and does not create a correlation matrix based on vectors generated therefrom.

Taguchi discloses an echo canceller with means for determining filter coefficients from auto-correlation and cross-correlation coefficients, but it is not seen where Taguchi discloses the detection of double-talk as defined in claim 1. Moreover, the teaching of Ding is that double talk is detected by comparing a generated an ERLE signal with a selected ERLE threshold level, whereas as discussed on page 2 of the application the use of ERL is associated with problems that the invention seeks to avoid.

Similarly Sano teaches nothing more than is acknowledged in the specification, namely the use of a single cross-correlation coefficient. Sano is referenced on page 3, line 9.

The novelty in the invention resides in the generation of a specific matrix and the detection of double talk from a characteristic value of the correlation between the components of the matrix. This solution overcomes the problem that the degree of correlation of the signals can vary widely with different signals and echo paths and provides effective double talk detection as illustrated in the Figures. In the applicant's respectful submission a combination of the prior art does not result in the invention as now claimed.

Thus, in the applicant's respectful submission, the prior art does not show either alone or in combination a method of detecting double-talk and path changes as defined in claim 1 by

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detecting changes in the characteristic value of the particular matrix as set forth and the subsequent step of adjusting the operation of the adaptive filter in response to the detecting step.

Reconsideration and allowance are respectfully requested.

Respectfully submitted,



Richard J. Mitchell  
Registration No. 34519  
Agent of Record

MARKS & CLERK  
P. O. Box 957, Station B,  
Ottawa, Ontario, Canada  
K1P 5S7  
(613) 236-9561